Menlo Park Notebook #111 [N-80-08-18]

This notebook covers the period August-October 1880. Most of the entries are notes, calculations, and drawings relating to tests of carbon lamps, commencing about 8:00 p.m. on October 6, 1880 and continuing until about 4:00 a.m. The entries are by Edison, Francis Upton, Francis Jehl, and other laboratory staff members. The few earlier entries also relate to lamp experiments. The label on the front cover is marked "Upton," "Oct 1880," and "Lamps Lot 1." There is an index on the inside front cover. The book contains 282 numbered pages.

Blank pages not filmed: 36-37, 278-279.

Missing page numbers: 235-236, 241-242, 253-254, 263-266.

Index.

Average of Lamps bursted—219, 258, 259, 261, 269, 271, 273, 275.
Analysis of Lamps tested—231, 233^{21}, 239^{88}, 245, 246, 267.
Carbons bursted and connected to Copper-Pole—187^{11}
Carbons bursted and connected to Zinc-Pole—187^{34}
Lamps—perfect—211^{12}
" —tested—1/4, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 31, 33, 39, 35, 41, 43, 45, 47, 49, 51, 53, 55, 57, 59, 61, 63, 65, 67, 71,
" — 73, 75, 77, 79, 81, 83, 85, 87, 89, 91, 93, 95, 97, 99, 101, 103, 105, 107, 109, 111, 113, 115, 119, 120, 121, 123, 125, 127, 129, 131, 133, 135, 137, 139, 141, 143, 145, 147, 149, 151, 153, 155, 157, 159, 161, 163, 165, 169, 171, 173, 175, 177, 179, 181, 183, 185, 189, 191, 193, 195, 197, 199, 201, 203, 205, 207, 209, 240, 247,
" —Blue at Clamps—69^{24}, 117^{27}, 167^{23}, 240^{43}
" —Not blue at " —131^{26},
" —Four connected—(Aug. 18, 1880)—32, (Vacuum)
" —Tables—212, 213, 214, 215, 216, 221,
" — " —223, 225, 227, 228, 229, 234, 237, 243, 249, 251, 255, 277.

TAE

Candle	Lamp No.	
		~~20 Cells = L 64. R 64.~~ 20 Cells = 32. E. M. F. 223.
32	1388	This Lamp had at one of its clamps the carbon broken, thus only a small portion was heated we did not put it up there to test its candle power
	1389	This Lamp when we had a small current on broke, it must have a very poor vacuum
	1431	

No 1406 TAE

32C This wanted
18 ft of German Silver
wire to make it
32 Cwhe Dif 222

No 1427

This Lamp required 8 ft when def was 223°

Lamp No 1379

This Lamp broke when there was a very small current on. it broke ~~at~~ near the clamps it seemed as if it had a poor vacuum

TAE

No 1574

This lamp was brought up to 32 C when it bust. The carbon was curved over so that the carbon nearly touch the glass, Def 223

1396

This Lamp was without any Res in the Circt 28.5 C Def being 223

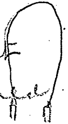
TAE

No 1360

This Lamp was at 32 C when adjusted so that it had 11 of the german Silver wire was put in, Def being 223. The carbon was curved.

No 1386

The carbon was split as shown and when the current was put on it would arc.



Def 223

TAE

No 1435

This Lamp was at 32 C when Res adjusted so as to have 15 feet of German Silver ~~Set~~. This Lamp was of German glass.

Def 223

No 1361

Carbon burnt. This Lamp burst when only a small current was put on. Must have a poor vacuum.

Def 223

TAE

No 1398

Bad Carbon. Three bad spots in it Did not test it.

No 1391

Bent Carbon

Bad Spots, one at the top, and another at the side near the clamp. did not test its C power

TAE

1382

This Lamp was at 32 C when it had 10 feet of german Silver wire Def 223.

refer also to page 16.

1380

This Lamp with 10 feet of german silver wire was at 32 C when def was 223

TAE

~~1373~~ 1428

Lamp at 38 C when E.M.F. 223. 20 cells = 32.

Ave Chem put this Lamp a 32 C & required 8 feet of G.S. Wire.

Def 225 L. R 228

No 1418

Lamp burst when at about 48 C

Def. 225 L. R 228

TAE

No 1382

Lamp at 48 C required 5 feet of German Silver wire. Def 225 L. 228 R

refer also to page 12.

No 1424

Lamp at 48 C required 10 ft of G. S. Wire Def L 225 R 228

TAE

No 1395

Carbon Little Burnt
7 feet required to make
it 48 C when def was
225 L. R228

No 1421

This to make it
48 C it wanted 11
feet of G. S. Wire
Def 226 L. R 228.5

TAE

No 1423

Low Vacuum
Carbon oxized when
small currents

No 1410

without Res 32 c
E ue 7. R 228 L 225

TAE

1420

5 feet to make it 32 C, a spot on one of sides. Def. 225 L 228. R.

No 1384

Carbon bent at 48 C when it required 3 feet of G. S. Wire Def R 230 L. 228

1433

Abt 48 C when it had 3 feet of G.S. Wire

Def 225 L. 228 R.

No ~~1386~~ 1391

Little bent

This has two bright spots, one on the side and the other near the clamp.

bushed on the bright spot on the side.

~~1386~~

Bad Carbon
busted at a low
current.

1422

E M 7 223

one side seemed to be
put on at 9.15 a great deal brighter
Than the other,
at 17 C 15 C

TAE

No 1440

5 mins Boss fiber was put in a nical mould and while white hot galoline gas was blown against it. I put it up at 48C. was up at five minutes then the engine stop.

TAE

In the morning put on at 48C at 8.33

In the morning was put on again at 8.33 at 48C

EM 7 = R 234. L 2.32

This Lamp bursted at 8.56

Making it 23 minutes that it Lasted.

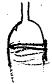
8.56
8.33
23

1

11-30 Blue running back one wire

11-36 reached the end of wire

11-38 commenced on other



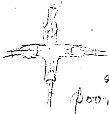
In gauge

11-40 Blue filling one side of globe

11-46 Reddish tinge. Just in tube, rapping in fall tube.

Aug 18.

The experiment with the four glasses (those which support the carbons). The one which had the



White ends had a slight red phosphorescence and green ~~on~~ ~~the~~ at the glass. poor vacuum,

The one with plain glass had a slight red phosphorescence but poor vacuum.

After dark

Spark tube alone

7.26 Blue on one wire

7.33 Glass green
Blue red

TAE

34 Completely blue on one wire red on other wire

Just before tube
35 dark around wire
1.36 commencing to spread on the other side light pink

reddish pink on one
7.37 side light on the other

bands of pink glass
bluish fluorescence,

Bands fading in color

7.39 One wire light pink the other
greenish. vac at 75

740 vacuum 78,

7-42 Vacu 85.
two bands very light blue.

7-45 Light blue [illegible]
V- 90
Vacuum soft went down to
78

Test on 100 lamps on table. Oct. 6, 1880

Lamps brought up to dull red and bad lamps picked out as followed

#26. Spotted.
#69 "
#81 "
#54 Bright at top.
#100. " " "
#44. arc. between clamps,
#54 vac. gone, oxidyzed at top
#99 #28. #66. carbon broken gave no light. never lighted in test - was busted in Gahls tests

73 - went in the clamp -

J Al

~~44 went [illegible]~~

Res on 44 · burned out

44 had a bad contact
in clamp sometimes it
would make good contact
& loop burn OK then you
would see sparks between
the carbon & clamp &
an arc light blue 1/4
inch dia jump across
then it would make

[illegible]

3:04

36.

got exhausted again
Iso in a [illegible]
One lamp brought
was just at red
while its neighbor
was giving about
8 candles; the one
that was red had
bad vacuum on feeling
the globe the 8 candle
was the coolest
shewing Enormous loss
Energy by air Conduction

in a low vacuum

time 8 oclock 5 min
~~Res~~
53 - abnormally high blue
95 Little higher that
ought to be -

Started 8,05 PM
EHgs watch
8.12 by clock -

✓54- went at top

Split

one ~~[illegible]~~ mins =
0.1 degree -

✓58. went at top 10 min

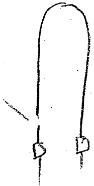
at 8.27 we found EMF Not quite right. took EMF from wires on table & brought it up 2 Volts more than the right amount to allow for heating of Res Coils

Natl. See p. 53

52 low.
53 abnormally High
51 fair.
55 "
56 "
59: fair
60 fair
62 } fair
61 }
63 High
64 fair
65 Extra fair
67. fair

68 fair
69 fair
70 fair
72
74 fair
76 fair
77 - fair
78 "
79
80 - fair
81
83 - very poor N.G.
bluish clay

✓ 49. went in Carbon -



26 minuts to 9.
8.34 PM

✓ 53- went in glass
8,34 ½

22 ½ min Total Time

84 - good
85 }
86 } fair
87 }
89 - little low
90 "
91 fair
92 little low
93 Low
95 Very bright
96 - fair
97 - fair
98 "
100 - low

See p 61

1 fair
2
3 high
4 high
5 fair
6 High
7 high
8 High
10 fair
11 good
12 good
13 fair
14 high
15 fair
16 fair
17 low
18 fair
19

20 low
21 very poor
22 fair
23 fair
24 little high
25 fair
26 bent bad spot high
29 pretty high
30 low
31 Low
32 fair
33 fair
34 fair
35 fair
36-7-8 fair
39 high

No. 95 – ~~8~~

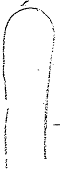
top

8.39 pm

total 27 m.

~~[illegible]~~

68 – went



8.41 pm

total 29 m.

Nov 26 - went 841 - it had bad spot - when it went it gave an arc as it burned its reset coil -

total time 29m

40 fair

41 fair
42
43 pretty fair

45 fair

46 fair

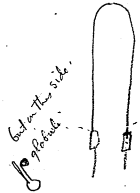
47 little high

TAP

48) fair
50)

/ Busted in Carbon

32 - time - 8.52 pm.


busted in Carbon
but on this side globule

plat clamp it
was fine on
The clamp -
investigate see if it actually
a plat clamp -

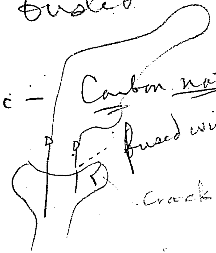
1 (Sic. Carbon vapor oriented by polarity gives the arc)

~~total~~ Time 40 m.

This shows that an arc
passed as the globule was
on the clamp where
Carbon melted + the Rail
Coil burned out at moment
of busting carbon

24 - time 8.56 pm

busted TAE



Arc - Carbon not busted

fused wire at glass

crack in glass

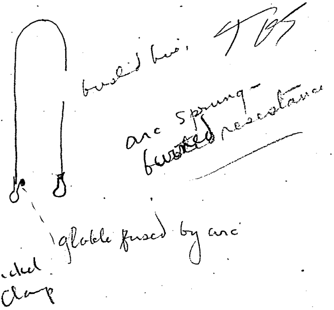
Risio burned
luna

plat clamps

~~[illegible]~~ no black on clamps
dont think there was blue. Evidently
the glass cracked let in air & an arc
sprung & burned the wires ~~the~~ over

The arc being below the carbon saved it + the platina being in partial vacuo of course got to melting point before pt outside in air

√ 69 – went at 9 oclock


fused here
arc sprung –
burned resistance
globle fused by arc
nickel clamp

List of those blue at Clamps at 903 –

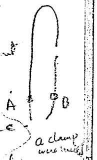
97 -
18
20
23
25
83
29
31
33

80
34
79
35
76
37
39
71

50
64
62
60 very little
57
52 good deal.
51

TAE

✓ No. 4 busted 9.08



The Carbon is broken & dropped down but cant say if it was by Current wire melted at glass. Res. burned out shewing arc

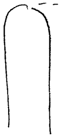
a clamp was here

~~but don't see how arc occurred unless~~

~~the Carbon [illegible]~~ Thing where the arc was from

doubtful?

✓ 37 - busted 909 -



THE

No 3 busted 9.21 - PM

busted in glass - arc

Resistance burned

plat clamps - no

black on them.

plat was not turned at

glass still standing

TAE

✓ No 14 Busted 9 22

arc-Res burned

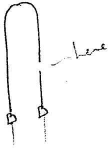
block on one clamp i-

plat wire burned at glass

TAE

√

39 - busted at 926

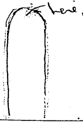


TAE

√

6 busted at 9-34

The resistance burnt first then the carbon oxydized all over gradually 5 sec.



✓

No 10 - at 939 pm

Busted in glass

Resistance burned

Carbon glues to all

humped -

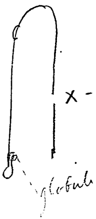
The

plat clamps

After test one of clamps

black at all

No 12 - at 9.46 pm -



TAE

arc across + busted Carbon at X

Resistance Burned

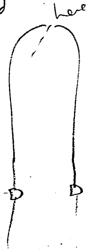
no black on clamps which are of platina.

√

No 35 9.47. pm busted

had bad spots unaccountably all the time

busted



TAE

Shows shining Carbon on parts of loop by Carrying

No. 9 at 9.54

Large
~~Coarse~~ bamboo

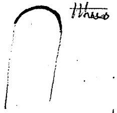
platina clamps
no black on them TAE

arc sprung Res.
burned

plat wire burned at
glass — Crack across
also

Think carbon was broken
mechanically

I notice in looking through blue specs that quite a number are brighter around the loop



TAE

also some few are bright near clamps

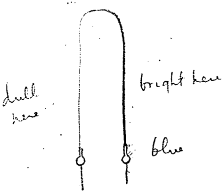
✓72 busted at 10,03 pm

platina clamp

had bad spot near clamp was rather high. arc sprung & melted plat 1/4 below clamp

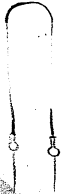
No 7

I notice No 62


dull here
bright here
blue

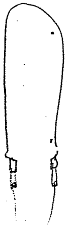
TAE

I notice No 33 · is lk



✓ No 7 - 10.09 pm

went.



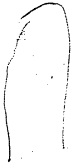
TAg

✓

No 33 - Went at 10 15 PM

Split on Carbon but not busted

lampblack in sprig



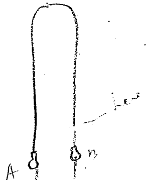
TAE

Arc sprung Resealing

burned -

But put other Res or rather
Cop wire when it
became incandescent & arc
sprung glass busted

No 13 at 1016 -



TAE

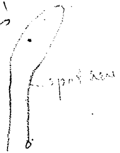
flat clamps
just slightly heating)
in A side
Res not [illegible]

✓
82 — 1019 pm —

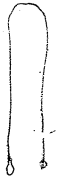
Busted in glass all went to pieces.

TAE

I make this



No 2. 1020 - pm



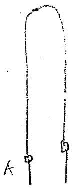
here little smoked in glass)

TAE

plat-clamp with block

Resistance did not burn

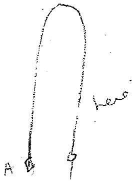
No 8. 1022 pm'


A
-- here little blackened in globe
plat clamp

TAE

Exceedingly slight tinge black on A.

No 63 – at 1025

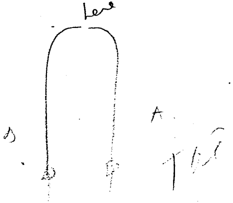


1 Ni

plat clamp here OK

plat clamp at A very black

62 busted at 1031



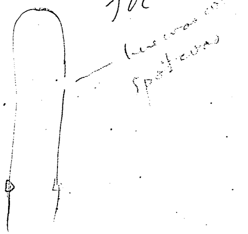
Nickel clamps Res OK.

Dont appear to be any Black on clamps but notice black on thick part of carbon & a polished carbon carrying
This was the lamp that was bright on A side & Dull on B

76 - at 1033',

had a spot. this spot kept on for about hour suddenly grew big in 5 sec, Vapor of Carbon shot out arc sprung Rec Burned

TAE


here was where spot was

1041 we stopped to fix brushes started again at 1050 -

9 - minutes to be subtracted -

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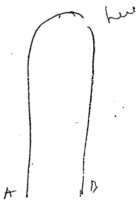
56 √ busted at 1054 TAE

Larger end was split in clamp probably made bad Connection as arc sprung & Burned Resistance, but Carbon intact

No 67 ✓ – busted at. 1056.



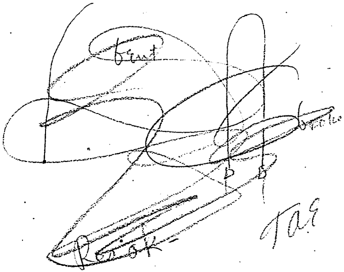
TAE

Nickel clamps – A very very black B somewhat black. arc sprung Res burned

I notice that the extra bad
Vacuum Lamps have their
Carbons very much bent over
these dont give more than 4 or 5 —
Candles. (threes only two -
There is not one Carbon in the
whole except the above two
that is not straight Enough
& the great majority are
quite straight =

TAE.

No 64 = ✓ at 11 13 pm


bent
broke
Rook

TAE

bushed here

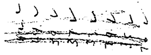
Nickel clamps thick
No Res in this one

11 25 pm

Blue at clamps

50 ✓
48
45.
34 ✓
31 ✓
30
29 ✓
25 ✓
23 ✓
22.
20 ✓
19.
18 ✓
100.
98
97 ✓
83 ✓

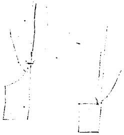
81
80 ✓
71 ✓
61.
60 ✓
59.
57 ✓
55.
52 ✓
51. ✓



TAE.

19 & 22 doubtful as one didn't take water about blue first 20 or 30 clamps

[illegible]-[illegible] 1[illegible] 19 22 45
48 81 [illegible] [illegible] 55 have
got blue since last taking
blue on page 69 —



79- at 1128.

TAE

Carbon was intact.
but could see that it was
badly split at clamp
& clamps were both
[illegible] blacked slightly
Kind of bluish oxyde —
are sprung - Resistance
burned out.

Question

200 — ohm

dif Emf between lamp &

300 ohm

16 candle as against 48,

vac

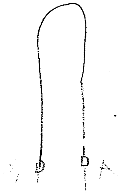
82/100 at 48

67/100 at 16 —

Then there is dif

temperature,

61 Busted at 1150



TAE

Nickel clamp — Spec of lamp

black on clamps on both

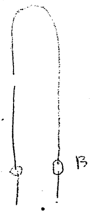
most on A.

Resistance 9 K

Some doubt being Expressed
that the Lamps (1e) majority
were at 48 candles I took
out a Lamp in Res. that
looked like 30 to 35 of the
majority were 48 & measured
candle power down stairs:
No was. 80. took off at 1155 put back
at 1205 am - measured 35 candles

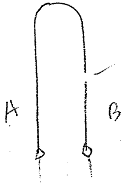
No 20 1155 TAE

Res OK



nickel clamps
block at A.
being carrying
Shunning Carbon
one side (1e) A. Carbon
on B side Block -

No 30. at 1150.



TAE

Shining Carbon
on A side black
on B Side.

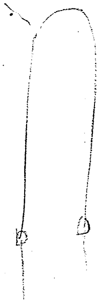
A clamp full Lampblack

Some on B . . .

arc (slight)
must have
sprung

Resistance Lowered
little

No 70 at 1158

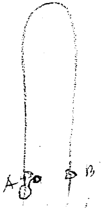


TAE

plat clamps
dont appear to be
black at all
Resistance Not burned

52 busted 1201 AM-

Arc spring



TAE

platina
Nickel clamp blade
on both.

Resistance burned.

The ones that have no blue are at 1210

96
93
92
91
90
89
88
87
86
84

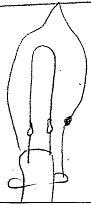
78
77
75
74
65
47
43
42
40
36
21

17
16
15
5
1

TAE

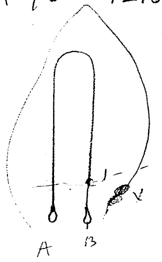
Phenomena.

See
132
Page



⊚ spot here on glass
as nickel clamp
is very close to it
glass perhaps
oxide from clamp

No 78 1216 AM.



TAE

saw while incandescent a spot here giving off vapor Carbon in straight line. this vapor impinging on glass gave this spot x which I suppose was due to nickel as set forth on page 132 — The arc suddenly grew large & then abnormally increased Resistance burned the side A on clamp when Carbon broke was white hot Carbon buckled where saw bright spots.

57-' at 1220 -

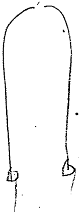
Exploded like a pistol -

TAE

No 100. 1235 am

Burned splendid & high
all Evening got spotty
last hour went at top

TAE

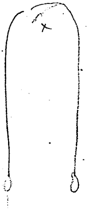


Carbon ~~putty~~
shiny showing
Carrying pbly
due to these spots

Nickel Clamps
has black spec
Lamp black

Res OK

25 " 1247-AM



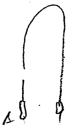
TAE

block on both clamp

x is a splint covered with Lampblack = rather smallened on glass - Resistance Ok.

74 - at 1250

TAE



nickel black on clamp A,

glass cracked

Rucatan burned

- trunk split in clamp

plat wire burned off on B side

83 at 1252 =

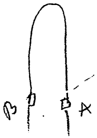
Bad one Cement touched glass then burned hole & oxidized all up — no R in

---

47. ✓ 1,02 am –

plat clamps
Res burned
burned off plat.
wire 1/4 inch from
Clamp on B side

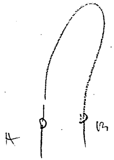
FAG



dont know yet
was broken by
Current or mechanically

one clamp slightly
black very slightly.

31 ✓ Lit 103 am

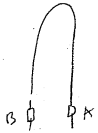


Shining carbon on a side also on B but there some black spots

Res OK 151 am TAE

Lampblack on B Clamp

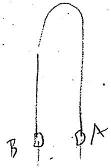
42 at 105.



Res burned arc.
plat clamp
both bright
burned platina
at glass, on A Side

TAE

59 — at 116 —



Res burned
arc sprung

Lamp black
all over glass in
Specs

A clamp very black

Has Mercury in globe

JWe

821

39-
60
60
60
60
40
60)319(

at 1.20 AM -

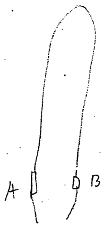
I pick out No 65 & Francis as a 48 candle lamp take it with its regulation down stairs to see if it is really 48 Candles = after taking it off I noticed globe somewhat blackened (but then there had been blue all over globe for some time) = measured 30 Candles but think that the blackening of the glass made big difference

We take at 1.37 am No 91 which appears very bright & find it to be 31 @ 2

Put 65 back at 1.40 am

46 at 130

Q_0



Res burned
arc sprung

A clamp
very black

Small End of screw on A
clamp fused

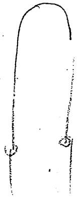
TAE

Apparently these lamps are about 30 candles instead of 48 = I dont believe that they have been any brighter than they are now & from these test ~~& judgment~~ its apparently as 30 candles for the brightest =

TAE

19 —✓ 155

Lamp black specs
allover glass Res
burned arc'd
both clamps—nickel
blued.



TAE

1-35 probably

at ~~135~~ am we

put no 91 which was

31 @ 32 Candles to 48

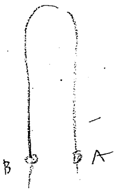
candles & brought all

the remaining lamps

to that EMF which

was 178 Volts.

No 55 145 am

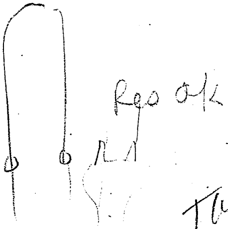


A very black

Res o/c B. slightly

TAE

96 ✓ 1 50 AM



plat clamps
both bright.

TAE

at 204 am

We Read blues at clamps
with 178 EMF or Volts

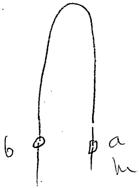
17
18
22
23
29
34
41
45
48
50

51
60
71
75
80
81
85
86
88

89
93
97
98

TAE

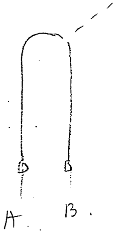
No 60 at 212 am



nickel clamps
Specs Lampblack on
a no Reco in
ckt

TAE

No 41 - at 213 am



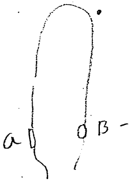
Nickel clamp

B, block

Res OK

TAE

84 at 215



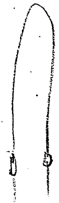
Res ok

arc, - Wire (platina)
of .B. melted at
glass

TAE

✓

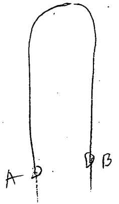
65= at 216 am



plat clamps
bright.
Res burned
by arc. Glass
nearly brown.

TAE

71 ✓ 216½ am-



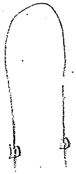
Returned arc

TAE

A very black large feathers of lampblack thrown over on glass

✓

Nov 15 at 230 am



plat clamps

Res OK

The

This is a clear straight

& to be expected but

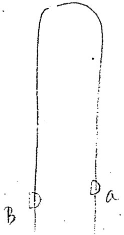
of the carbon

No black on clamps

at 230 am .6 hours & 20 minuts from start 33 lamps still going out of 97 that started

TAE

51 at 235 ✓



Specs lampblack
thrown on glass

Res Grounded

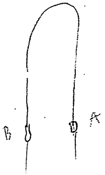
Specs lampblack
on a & B Grounded

better lampblack

TAE

✓

No 22 237 am



Res burned

A clamp nickel
very black

Mercury in globe

B clamp browned

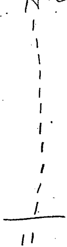
TAE

Carbons busted towards + connected to ~~Z~~ Zinc pole

15
19

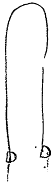
34

Towards + connected to Copper pole



TAE

No 16. 2 43 am

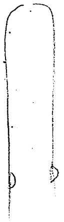


Res OK

flat clamps No
black

broke as it showed in
Carbon TAE

21 247 am-



no Res
Low 2 ly
more 7 candles
than 1, Candle

TAE

29 Lamps alive at 3 oclock -
178 Volts test

38 at 310.

Split in Clamp

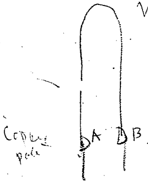
Arc went but didnt
injure Res - one clamp
got white hot & in
3 seconds glass broke
& busted Carbon
all pieces mechanically

TAE

No 18 322

Shiny Carrying Spec's Lamp black on nickel clamps

Res OK


Copper pole
A
B

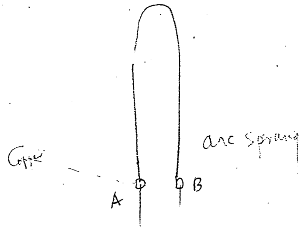
Carbon block B side -

Shiny Carbon A side

TAE

81 - ✓ 3 31 am

Res turned


Copper
arc sprung
A
B

A very black in nickel clamp -

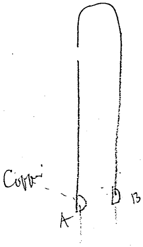
Carbon at A apparently a little loose in clamp.

50 - 334 am

Arc - Resburned
platinum melted
at glass
Carbon so broken
Cant tell

TAE

97- 334½ am



Res not burned

Little black on
nickel clamps
specs Lampblack
thrown on glass
near brakd filament
of it hanging to
Carbon near break.

TAE

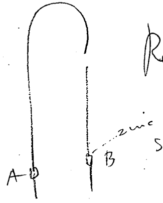
with the 178 volts
No 91 has fallen
from 48 candles at 2 oclock
to - 39 candles at 356 am showing
~~that~~ air comes out &
reduces economy even
after it has been at 48 -

They now use 91 &
increase the volts to
_____ & bring 91 to 48
candles again - and all
the other lamps come
up with it -

TAE

23 lamps burning at 4 am

85′ at 404 am



Res OK

Specs Lamp black or burz on glass near break

A block in clamp

TAE

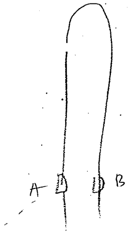
---

91 = Irons changed on poles

Busted 8,10, am

Res OK – no arc globe clean

34 = at 350 am



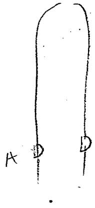
Carrying Shiny Carbon on B Side

A zinc block

Res OK

TAE

80 ✓ at 406



Res OK.

Carrying + Shining Carbon on A Side.

A-block nickel clamps -

TAE

No 1
Busted 7.35 am

~~negative~~

~~Put on~~

~~glass clean~~
~~Res OK -~~

~~47 Cot 1~~

~~1.30 P.M.~~

~~Res burnt.~~

Stopped at

Nos These Lamps are to be taken off & tested for Economy

47✓ 17×✓
45×✓ 86✓ 98✓
43×✓ 87✓ 1 ✓
40×✓ 88✓ 5 ✓
36×✓ 89✓
75×✓
~~33× B~~ 90✓ 91✓
92×✓
93×✓

TAE

put these lamps down to yellow & found 12 perfect No Spots

Platina	Nickel	Res Burnt	Bad	
24		/	/	carbon welded but wire burnt [illegible]
	25		/	
	26	/		
~~29~~			~~/~~	Whole white deposit on carbons
	30	/	/	White deposit on carbon
	31		/	
32		/	/	
	34		/	
	35		/	
37			/	
38			/	
	39		/	
	41		/	
42		/	/	
	44	/	/	

Platina	Nickel	Res. Burnt	Bad
No 2			/
No 3			/
No 4		/	/
No 6		/	/
No 7			/
No 8			/
No 10		/	/
No 9		/	/
No 12		/	/
No 13			/
No 14		/	/
No 15			/
No 16			/
~~No 18~~	No 18		/
	No 19	/	/
	No 20		/
	No 21		/
	No 22	/	/
	~~No 23~~		/

Marked not in the book white deposit on carbon

TOP

Platina	Nickel	Res Burnt	Bad
	46	1	1
	48 ②		1
	v 49		1
	50	1	1
	51	1	1
	52	1	1
	v 53		1
54✓			1
	55		1
	56	1	1
	57		1
	58✓		1
	59	1	1
	60		1
	61		1
	62		1
63			1
	64		1
65		1	1

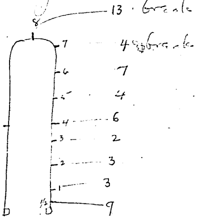
[illegible]

(66?) not in exhibit

Platina	Nickel	Burnt Res	Bad
	67	1	1
68			1
	69	1	1
70			1
	71	1	1
72		1	1
	73		1
	74	1	1
	76	1	1
77		1	1
	78	1	1
	79	1	1
	80		1
	81	1	1
	82		1
	83		1
84			1
	85		1

Platina	Nickel,	Res Resist,	Bal
	95		/
96			/
	97		/
	100		/

Analysis


13 · break
8
7
4 breaks
6
7
5
4
4
6
3
2
2
3
1
3
1/2
9
D
D

The breaks occur on both sides but I have marked them all on one side

TAE

	Volts	Ohms	Ft. lbs. min	
1	147	188	5090	
2	143	172	5260	
3	152	188	5440	
4	137	154	5400	
5	140	167	5200	
6	154	195	5380	
7	158	188	5880	
8	156	180	5990	
9	156	182	5910	Carbon broke
10	143	178	5090	
1	143	177	5120	
2	156	209	4920	
3	141	183	4810	
4	148	195	5040	
5	146	177	5340	
6	137	169	4920	
7	142	179	4990	TAE
8	143	204	4440	
9	146	~~[illegible]~~ 179	5480	
19	27.68	3464	99700	

	Volts	Ohms	Hrs	
20	154	201	5230	
1	~~too~~	~~high~~	—	
2	140	168	5170	
3	140	172	5050	
4	160	239	4750	
5	142	158	5656	
6	154	191	5500	
7	~~Broke~~	~~in~~	~~testing~~	
8	~~Broke~~	~~in~~	~~testing~~	0
9	142	168	5320	
30	142	158	5656	
1	154	211	4980	
2	160	196	5780	
3	162	233	4.996	
4	148	189	5130	
5	164	223	5240	
6	144	183	5.020	
7	148	185	5250	
8	128	177	4230	
9	152	172	5950	
20	2334	3224	99008	

TAE

		Volts	Ohms	Hrs.	
	40	134	163	4888	
	1	148	208	4660	
	2	148	192	4850	
	3	138	171	4930	
0	4	156	202	5340	0
	5	144	212	4320	
	6	142	177	5046	
	7	140	171	5677	
	8	142	163	5480	
	9	174	213	6296	26
	50	158	206	5437	
	1	146	180	5246	
	2	168	192	6516	
	3	132	182	5623	oxydized 10
100	4	too high			
	5	164	198	6017	
	6	160	201	3642	
	7	164	188	6348	
	8	Broke in testing			
	9	148	194	5001	
	20	2706	3413	96537	

0

103151
5157.

	Volts	Amps	Ft lbs	
60	146	214	5706	
1	156	179	6022	
2	158	212	5216	
3	152	191	4918	
4	160	233	4867	
5	142	168	5317	
6	156	198	5448	Carbon broke
7	152	207	4944	~~carb~~
8	162	217	5357	
9	144	194	4735	
70	150	201	4959	
1	144	169	5435	
2	150	200	4983	
3	162	231	5033	
4	154	200	5253	
5	134	162	4910	TAE
6	150	199	5008	
7	146	197	4800	
8	144	191	4810	
9	156	210	5130	
20	3038	3973	103151	

Lamps	Volts	Ohms	Ft lbs
21	2490	3062	82255
20	3038	3973	103151
20	2706	3413	96533
20	2534	3224	99068
19	2708	3464	99700
1[illegible]	13476	17136	480651

9 Bad

92

~~Volts~~
~~92)13476(146~~
~~92~~
~~427~~
~~368~~
~~596~~
~~552~~
~~44~~

~~Ohms~~
~~92)17136(186~~
~~92~~
~~793~~
~~736~~
~~576~~
~~552~~
~~24~~

~~92)480651(5224~~
~~460~~
~~206~~
~~184~~
~~225~~
~~184~~
~~411~~
~~368~~
~~33~~

146 average in Volts.
186 " " Ohms
5224 " " Ft-lbs.
No of Lamps 92 good

	Volts	Ohms	Ft-lbs
80	144	182	4840
1	146	198	4778
2	Too high		
3	Too high		
4	136	167	49[illegible]
5	138	168	5030
6	138	179	4720
7	138	171	4960
8	136	125	4430
9	142	203	4352
90	124	164	4053
1	132	160	4825
2	146	183	5242
3	152	200	5117
4	Broken testing		
5	140	178	4877
6	142	185	4828
7	148	167	5199
8	144	171	5377
9	Broken		
100	152	204	5017
21	2490	3062	82255

TAE

Average of the 91 lamps tested

13476 4.1294

91 lamps 1.9590

2.1704

148 Volts

17136 4.2336

1.9590

2.2748

188.2

480641 5.6818

1.9590

3.7228

5282 4.5185

.7957

6.2 per H.P 1.6812

46 2.4769

TAE

300 candles per H.P.

~~Total Ohms~~

~~24/3968/165~~
~~24~~
~~156~~
~~144~~
~~120~~
~~120~~

~~24/116003/4833~~
~~96~~
~~200~~
~~192~~
~~72~~
~~83~~
~~72~~
~~11.~~

~~24/3174/132~~
~~24~~
~~77~~
~~72~~
~~54~~
~~48~~
~~6~~

~~Average in Ohms 165~~

~~Average in Foot Pounds 4833~~

~~Average in Volts 132~~

~~With 24 lamps~~
~~Poles off the clamps.~~

Averages of 21 Lamps with blue on the clamps.

Total Volts.
21/3174
151 Average.

Total Ft lbs.
21/116003
5523 Average.

Total Ohms.
21/3968
188 Average.

~~Blown at~~

Lamps	Minutes
58	10
49	22
68	28
82	40
37	57
39	74
76	142
61	209
20	214
30	215
52	220
57	239
10	254
25	266
83	271
31	282
59	295
19	314
55	324
60	351
71	356
51	374
22	376
21	385
18	421
81	440
50	443
97	444
34	459
80	475

30

Out by FRU

0-100 minutes 15 Volts 163 Ohms 208 Ft. Cts 5725

100-200 minutes 12

200-300 minutes

Total Lamps

TAE

22159

Average burning time of 82 lamps which did not last of first lot from the factory.

Total no of min 22159.
" " " Lamps 82
Average ———— 270 min

~~Three~~ Six lamps lasting at about 700 min = 4200 ~~[illegible]~~ which added to the total makes the

Grand Total, ~~24259~~
Total No of lamps. ~~51~~ 88 lamps
Average —— ~~[illegible]~~ min,
22159.
299

Refer to. Page 247

T.A.E.

43 lamps that were blue at the clamps out of

38

Unaccounted for

23

~~9~~, 11, 27, ~~28~~, 29, 44, 48

~~66~~, 73, 94, ~~99~~

8 lamps

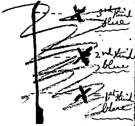
3 lamps broken at first

11 lamps

89 lamps to be accounted for

On table 89

No of Lamp	not Blue	1/3rd "	2nd third "	3rd "	No of Lamp	Not Blue	1st third blue	2nd "	3rd "	No of Lamp	no Blue	1st third blue	2nd " blue	3rd " blue
□ 1	0	0	0	●	□ 40	0				✓ 80		0	X	X
✓ 2	0				✓ 41	0				✓ 81		0	0	X
✓ 3	0				✓ 42	0				✓ 82	0			
✓ 4	0				+ 43	0				✓ 83		0	X	X
+ 5		0	0	0	~~44~~		~~X~~	~~0~~	~~0~~	✓ 84	0			
✓ 6	●				+ 45		0	0	X	✓ 85	0			
✓ 7	0				✓ 46	0				+ 86	0			
✓ 8	0				□ 47	0				+ 87	0			
# 9	0				~~48~~		~~0~~	~~0~~	~~X~~	□ 88	0			
✓ 10	0				✓ 49		X	0	0	+ 89	0			
~~11~~	~~0~~				✓ 50		X	X	X	+ 90	0			
✓ 12	0				✓ 51		0	X	X	□ 91	0			
✓ 13	0				✓ 52		X	X	X	+ 92	0			
✓ 14	0				✓ 53	0				+ 93	0			
✓ 15	0				✓ 54	0				my side ~~94~~	~~0~~			
✓ 16	0				✓ 55		0	0	X	✓ 95	0			
□ 17	0				✓ 56	0				✓ 96	0			
✓ 18		0	X	X	✓ 57		X	X	X	✓ 97		0	X	X
✓ 19		0	0	X	✓ 58	0				+ 98		0	0	X
✓ 20		0	X	X	✓ 59		X	0	X	# ✓ 99	0			
✓ 21		0	X	X	✓ 60		X	X	X	✓ 100		X	0	X
✓ 22		0	0	X	✓ 61		X	0	X					
~~23~~		~~0~~	~~X~~	~~X~~	✓ 62		X	X	0					
✓ 24		0	X	0	✓ 63	0								
✓ 25		0	X	X	✓ 64		X	X	0					
✓ 26	0				✓ 65	0								
~~27~~	0				# 66		X	0	0					
# 28	0				✓ 67	0								
~~29~~		~~0~~	~~X~~	~~X~~	✓ 68		X	0	0					
✓ 30		X	0	X	✓ 69	0								
✓ 31		X	0	X	✓ 70	0								
✓ 32		X	0	0	✓ 71		X	0	X					
✓ 33		0	X	0	✓ 72	0								
✓ 34		0	X	X	~~73~~		~~X~~	~~0~~	~~0~~					
✓ 35		X	X	0	✓ 74	0								
+ 36	0				+ 75	0								
✓ 37		X	X	0	✓ 76		X	0	0					
✓ 38	0				✓ 77	0								
✓ 39		X	X		✓ 78	0								
					✓ 79		0	X	0		56	22	22	25



not blue 0

refer to Pages

69 - time 9.03 P.M.

Page 117

11.25 P.M

Page 131

12.10 P.M

TAE

was found to be

Summary Lot 1

The average of all the 91 lamps tested pp. 221 — 231

Volts	Ohms	Foot lbs
148.	188.2	5282.

That is 300. candles were obtained per Horse power

Record was kept of 89 lamps; the average burning time ~~is~~ 310 minutes

38 lamps were blue at the clamps. The average of 27 of these gives

Volts	Ohms	Ft. lbs.
157.	152	5352

The average burning
time of th

88 lamps 22159
No 40 = 1350
" 47 = 1050
" 1 = 745
" 17 = 709
" 90 = 790
" 96 = 706
703
27601.

— Average time of burning
of 82 Lamps which burnt
their Resistance coils.
Old Minutes

Average burning time of 82
Lamps which did not burst of 1st
lot from factory
Total No of Min = 22159
" " Lamps = 82

Average = 270 Minutes.

Also 6 Lamps which lasted
about 700 Hours = 4200 Minutes
which added makes a grand
total of = 26359 which
gives an average of the
88 Lamps of 299 Minutes

82l - 22159
1350
1050
745
703
790
706
703
89l 27601 Total Min.

Average for 89 lamps
310 Min

TAE

Lot 1.

Lamps that broke in the succeeding 50 minutes.

	During the time	Total	%
0 - 50	10	10	11.1
50 - 100	9	19	21.3
100 - 150	11	30	33.6
150 - 200	4	34	38.1
200 - 250	7	41	45.9
250 - 300	8	49	54.9
300 - 350	4	53	59.8
350 - 400	10	63	70.7
400 - 450	5	68	76.3
450 - 500	6	74	83.4
500 - 550	1	75	84
550 - 600	2	77	86.5
600 - 650	3	80	90
650 - 700	3	83	93.4
700 - 750	3	86	96.6
750 - 800	1	87	97.7
800 - 850	0	87	97.7
850 - 1000	0	87	97.7
1000 - 1050	1	88	98.8
1050 - 1300	0	88	98.8
1300 - 1350	1	89	100

TAE

Lot No 1

Time	Nos	Perct	Time	Nos	Perct
from 0 to 50 minutes.	54 58 49. 53 95 68 26 32 24 69 10	11 19/21 %	from 150 to 200 minutes	56 67 64 79 33	39 2/7 %
from 50 to 100 minutes	4 37 3 14 39 6 10 12 35. 19	= 21 3/7 %	from 200 to 250 minutes	61 20 30 70 52 78 37 40	47 13/21 %
from 00 to 100 minutes.	72 7 33 13 82 2 8 63 62 76 29	34 11/21 %	from 250 to 300 minutes	100 25 74 83 77 31 42 39 48	JM 57 1/7 %
			from 300 to 350 minutes	46 19 55 96. 52	61 19/21

(over)

Blot on the Next Page

torn out by Dummy

Nos	Time	Per ct	Nos	Time	per ct
60		from 500 to 550 minutes	45	74	$88\frac{3}{21}$ %
41					
84					
65	from 350 to 400 minutes	per ct			
71		from 550 to 600 minutes	75		$90\frac{10}{21}$ %
15			93	76	
51	per ct $73\frac{17}{21}$ %				
22		per ct			
16		from 600 to 650 minutes	90		
21			92		
62			5	79	$94\frac{1}{21}$ %
38	from 400 to 450 minutes	per ct			
18			36		
81		from 650 to 700 minutes	89		
50					
97	per ct $79\frac{16}{21}$		98	82	$97\frac{13}{21}$ %
67					
34	from 450 to 500 minutes	per ct			
85		from 700 to 750 minutes	91		
80			17		
87				84	100 %
43					
86	per ct $86\frac{19}{21}$				
73					

Tae

48 candles. ~~going yet 745 pm.~~
(1421) Muffle pretty high - higher than ordinary - bad spots
new way clamping - Vac - high
4 hours 10 min

48 candles
1424 ditto 3 hours 30 mins - new clamping
no spots - Vac High

48 candles
1382 - gas f corrugation. 1.45 no spots high Vac
old clamping - 1,45

32 candles
1427 = Muffle f = higher than ord - bad spots high
Vac - new clamping - 2 hours 13 min -

48 candles
(1384), Gas furnace - no spots split in clamps =
going yet 745 pm - burnt very much.

48 candles
1395 = Gas furnace — 2 hours 13 mins clamped old
no spots - high Vac - lasted 2.13

32 candles -
1428 - muffle high heat - bad spots high Vac.
Corrugated clamped new way - 3 hours

32 candles
(1380) - Gas furnace - old clamping, no spots
high Vac - on yet 750 -

32 c
1360 ~~Co~~ Gas furnace — Covered till
touched glass - no spots split in clamps
Vac 95 old clamping 1 hour 35 min -

32 c
1435 - Muffle high heat - clamped new
way - German glass = no spots - not
bent - good = on yet 752 - pm.

32 c.
1420. Muffle high heat - new way clamping
- high Vac - 2 hours 20 min
bad spot

32 - c
1406. Muffle intense heat - old clamping
glass buckled, no spots high Vac
3 hours

48 c
1433 - muffle high heat - bad spots high
Vac 1 hour 15 min.. new clamping

32 c
1410 ~~Muff~~ Gas furnace then put in Muffle at intense heat 11 minutes - high R - bad spots

TAE

Summary of Lot 1 TAE

The average of all the lamps tested (91) to be found on pages 221 to 231

Volts.	Ohms.	Foot-lbs.
148.	188.2	5282

That is 300 Candles per Horse Power were obtained

From the record kept of 89 lamps the average time of burning was found to be 310 minutes

Thirty-eight (38) lamps were blue at the clamps the average of 27 of these gives.

Volts.	Ohms.	Foot-lbs.
151	152	5352

Nothing important on next 12 pages
torn out by Hammer.

---

minutes
82/22041
268 average for 82 lamps
of Lot 1

```
 22041
  1350
  1050
   745
   703
   790
   701
   103
89/27483
```

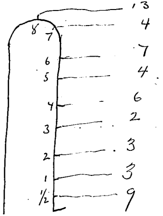
minutes
308 average for
89 lamps.

Average time of burning of 32 lamps in first test which burnt their resistance 198 minutes.

On page 249 is the table showing the number of lamps that gave out during the succeeding 50 minutes.

On page 219 is an analysis of the places at which the lamps broke

51 lamps


8
7
6
5
4
3
2
1
½
13
4
7
4
6
2
3
3
9

TAE

On page 243 is a table showing the lamps that showed blue at the clamps

TAE

Result.

These lamps were made with very poor vacuums and in a number of cases the sealing of the wires through the glass was defective. The wire was simply run through the glass of the inside part which was sucked in.

The lamps that TVQ lasted the longest were those which took below the average E.M.F. to bring them to ~~thes~~ 48 candles. Lamp. 40 which lasted 1350 minutes showed at the end of that time no slackening on the clamp

It was tested twice for economy and was found ~~the~~ to be a fraction less economical at the end of the test than at the beginning though practically the same. The resistance and E. M. F were also practically unaltered. This shows that when the lamps are sufficiently exhausted that they are permanent.

All the lamps that were blue at the clamps at the beginning of the test gave out before 700 minutes.

Lot 1 – Test lamps.

No.	Volts.	Ohms.
16	133	177
17	145	179
18	141	193
19	123	188
20	199	213
~~21~~	~~too high.~~	
22	120	168
~~23~~	~~[illegible] high~~	
~~24~~		
25	122	180
26	132	269
29	120	177
30	127	166
31	155	223
32	141	206
33	136	194
34	126	197
35	157	232
15 lamps	2077	2962

Volts.

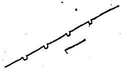
15 | 2077 | 138
15
57
45
127
120
7

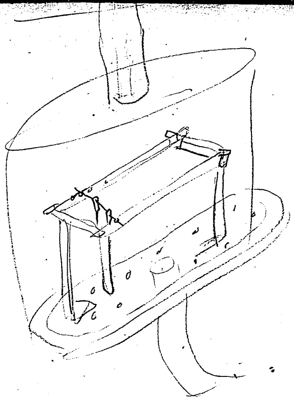
15 | 2962 | 197
15
146
135
112
105
7

197 Ohms

138 volts

TAE





TAE

2 2

33) 2850 (8.6
264
210
198

33) 267 (7

33) 250 (7
231
19

33)267 (8

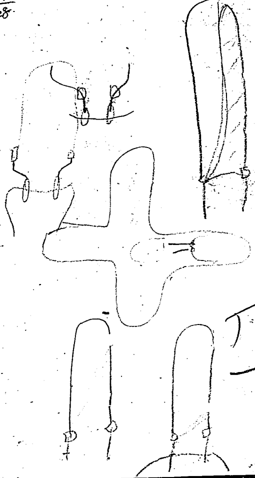
33)258 (8

21.6
8.6
1296
1728
185.76

21.6 4
7
151.2

21.6
8
172.8

33)258 (8



T.M.